

Aerospace Technology Operations Space System Contamination and Lubrication

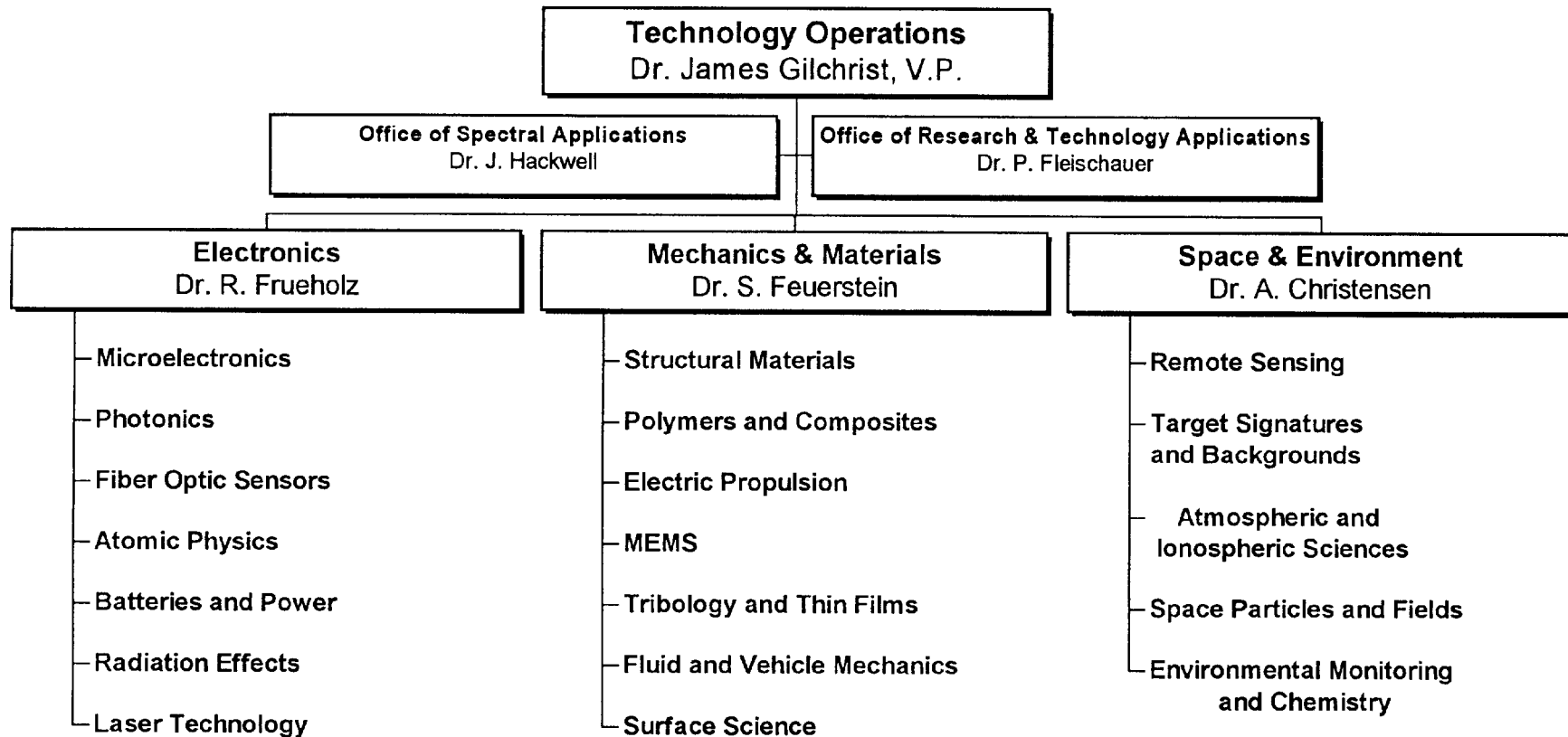
Government Technology Capabilities Briefings Space Based Laser Concept Definition Study

**March 12, 1998
Dr. Graham S. Arnold
Surface Science Department**

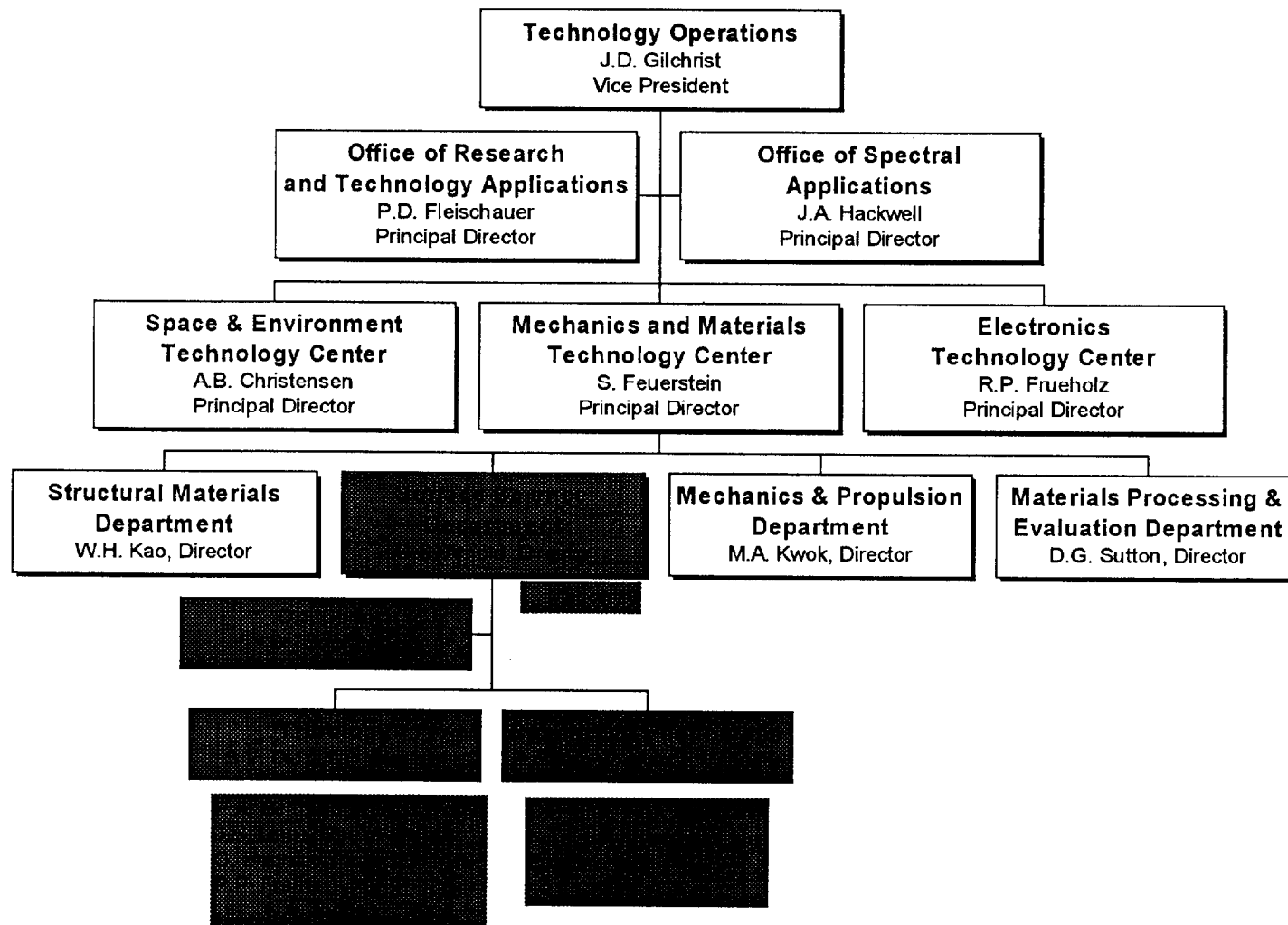
Outline

- Organization Description
- Organization Functions
- Technical Capabilities
- SBL Support

Technology Operations



Surface Science Department



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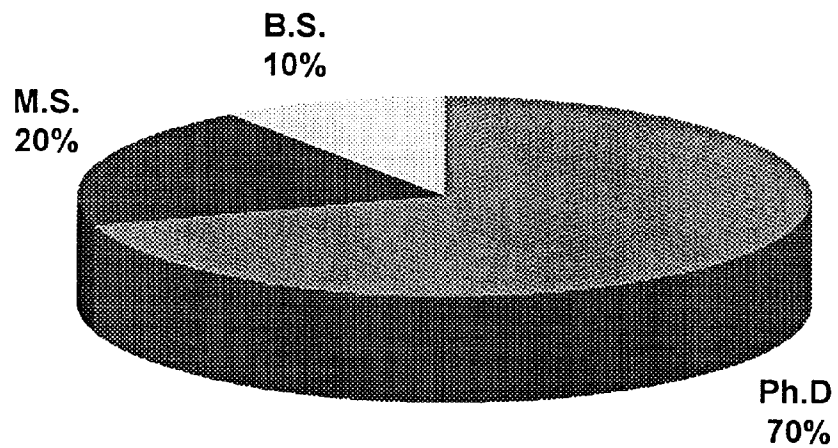
Technology Operations center of expertise
in surface and interfacial sciences.

- **Tribology Section**
 - Spacecraft Lubrication
 - Wear Resistant coatings
 - Surface Science
- **Spacecraft Phenomena Section**
 - Contamination Control
 - Contamination Processes
 - Space Environment Effects on Materials (flight tests)

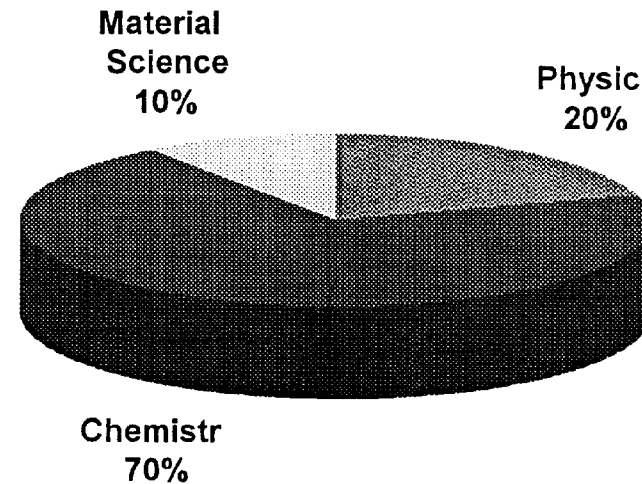
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Staff Education

Highest Degree

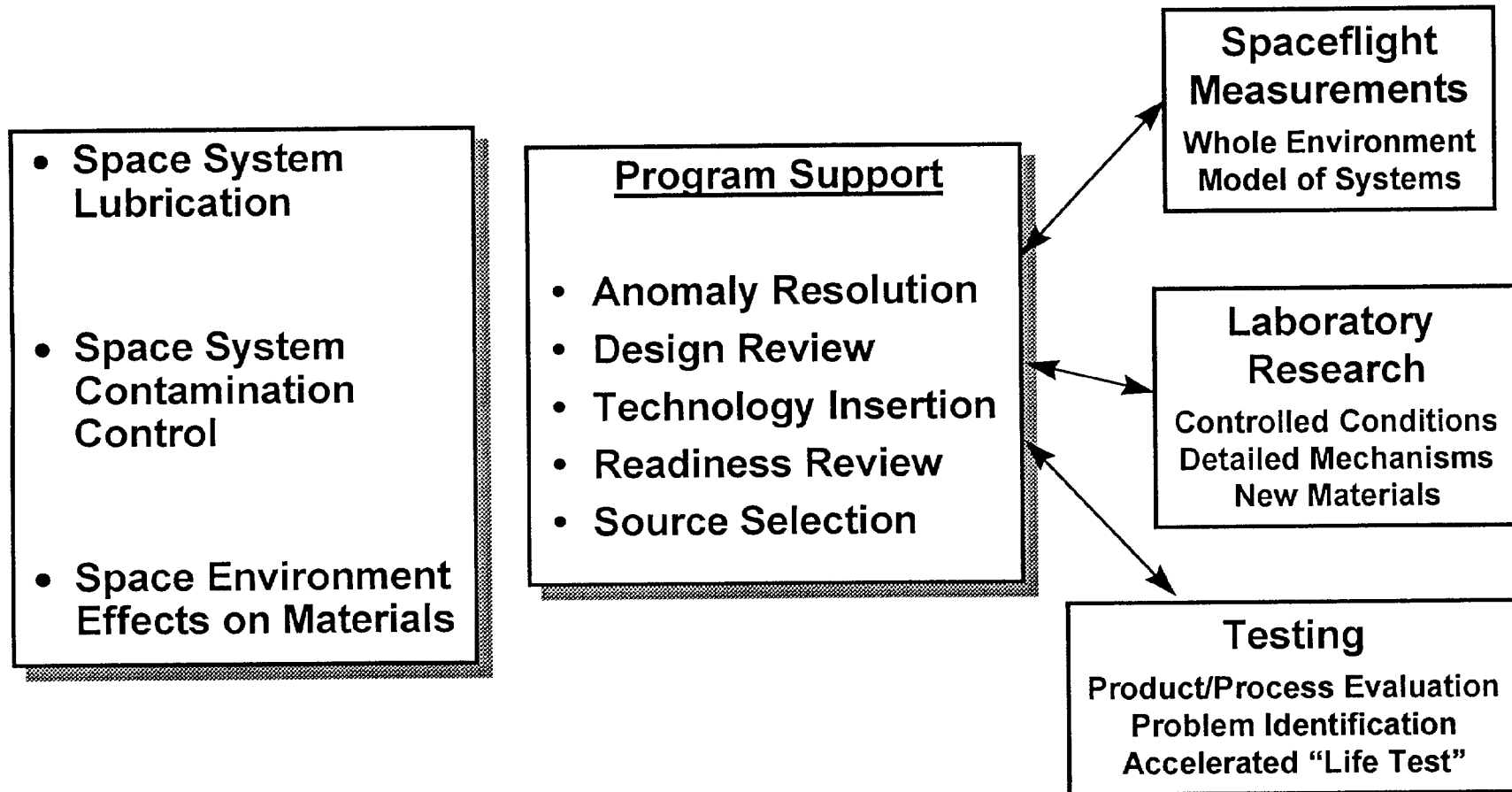


Specialty



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Technical Areas and Functions



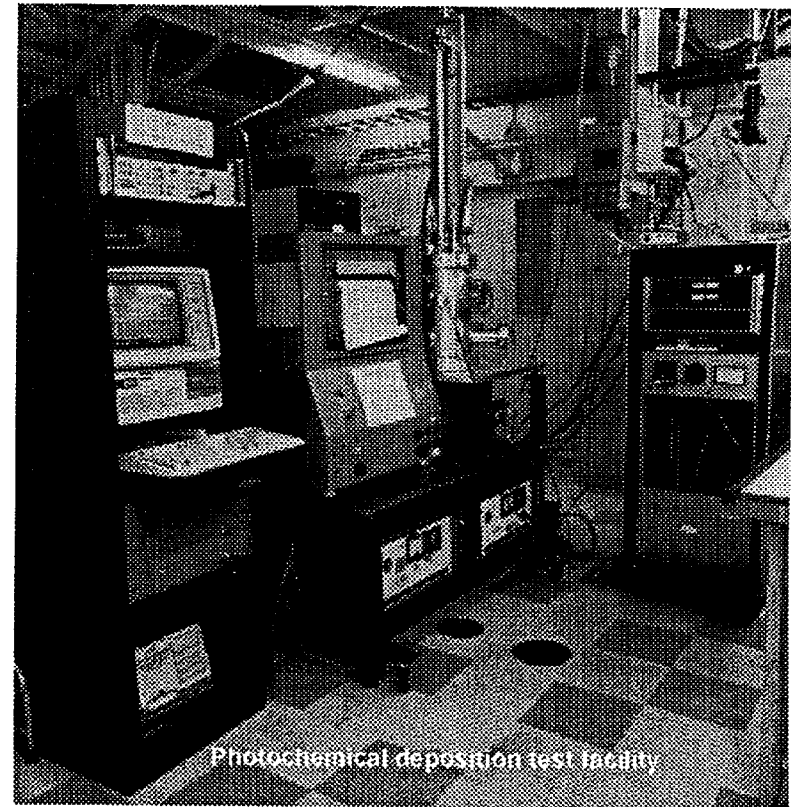
Spacecraft Contamination Processes

Capabilities

- Photochemical deposition test facility
- Outgassing and deposition test facility
- ASTM E595 outgassing test
- Spacecraft contamination model (in development)

Utilization

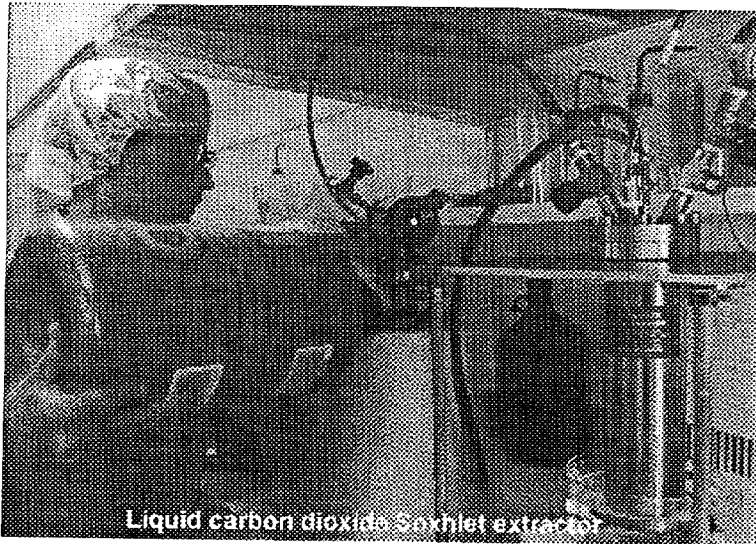
- Optical properties of contaminant films (CDP)
- T4 Stage II oil flow contamination effects (SMC, CDP)
- Pegasus fairing contamination recovery (SMC)
- GPS solar array contamination analysis (SMC)
- ISS Tefzel wire outgassing, photodeposition (NASA)



Contamination Control Laboratory

Capabilities

- Class 1000 Clean Room
- Optical and electron microscopy
- Infrared, optical and surface spectroscopy
- Non-volatile residue analysis
- Witness samples for remote site diagnosis



Liquid carbon dioxide Soxhlet extractor

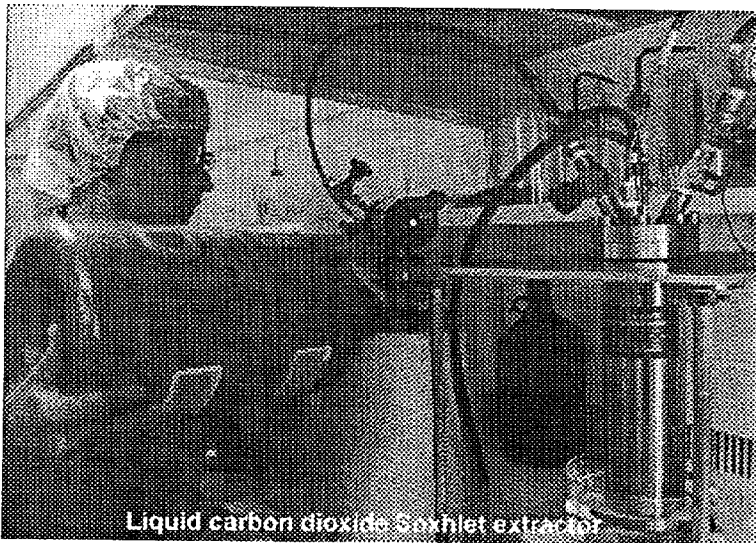
Utilization

- K14/DSP 17 contamination event recovery (SMC)
- Pegasus fairing contamination analysis (SMC)
- TitanII/DMSP launch processing pathfinder (SMC)
- Titan IV flow control valve failure recovery (SMC)
- Ozone depleting chemical replacement (SMC, CDP)
- Carbon dioxide liquid and snow cleaning

Contamination Control Laboratory

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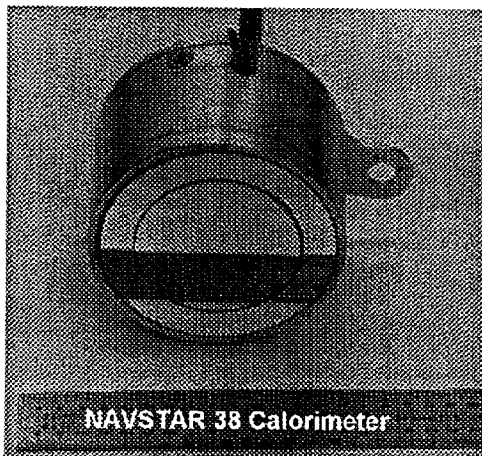
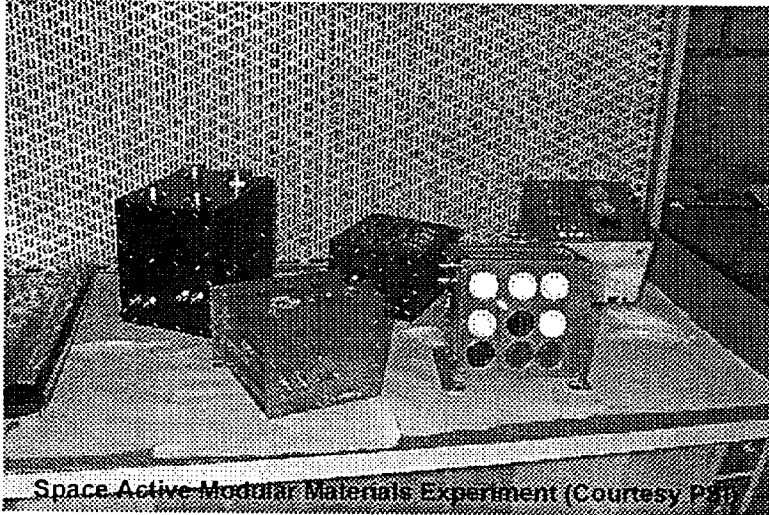


Liquid carbon dioxide Soxhlet extractor

Utilization

- K14/DSP 17 contamination event recovery (SMC)
- Pegasus fairing contamination analysis (SMC)
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Spacecraft Contamination Flight Tests



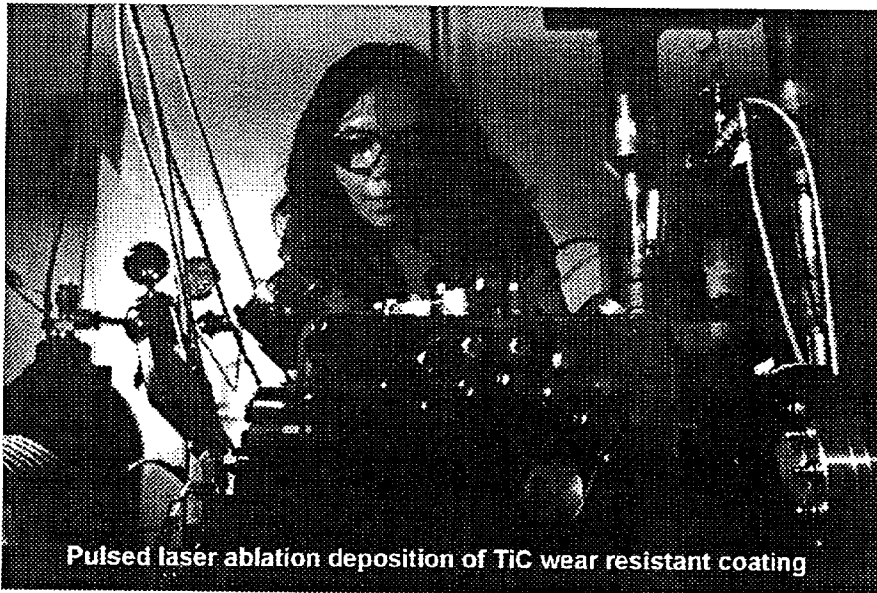
Projects Supported

- Diagnostic Instrumentation Package, P.I. (CDP)
- Space Active Modular Materials Experiments, P.I. (JPL/BMDO)
- Midcourse Space Experiment, Co.I. (BMDO)
- GPS solar array flight test, P.I. (SMC)
- SCATHA/ML12 (AFRL, SMC)

Wear Resistant Material Research & Development

Capabilities

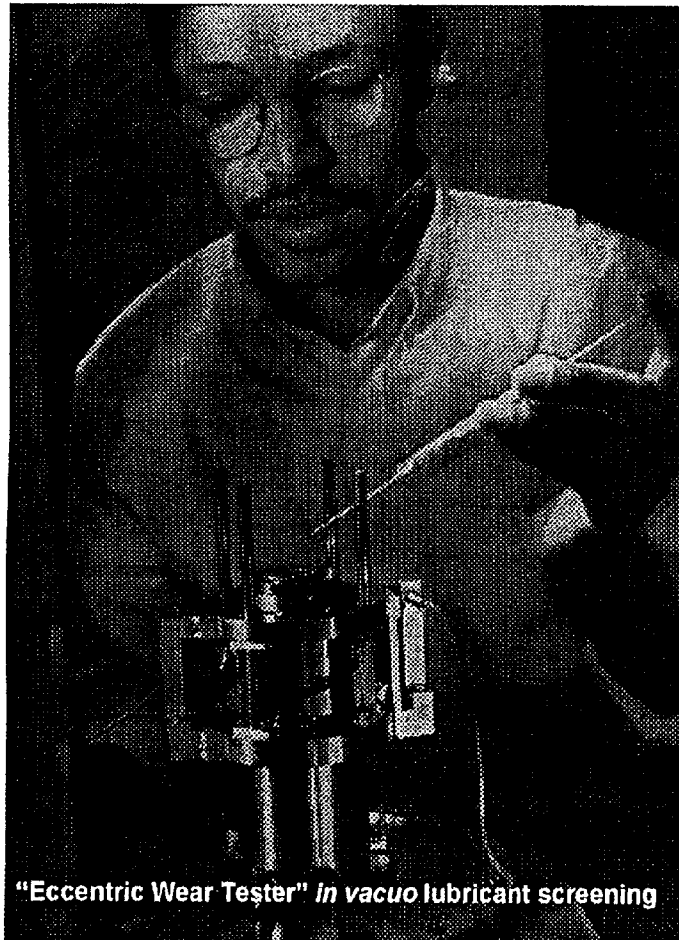
- Laser ablation deposition facility
- Nanoindenter hardness tester
- Atomic force microscope
- Accelerated wear testers



Utilization

- Advanced coating deposition techniques
- Hard coating performance evaluation (AFRL)
- Coating technology assessment (CDP)
- Hard coating surface chemistry (UH/AFOSR)
- MEMS tribology
- Lubricant Chemistry (UofH, CDP)
- Ceramic Bearing Technology (CDP)

Lubricant Research and Testing



"Eccentric Wear Tester" *in vacuo* lubricant screening

Capabilities

- Unique *in vacuo* lubricant screening test
- Unique solid lubricant deposition facility
- Ultrahigh vacuum tribometer
- Bearing evaporative oil loss model

Utilization

- Synthetic lubricant performance verification (SMC, CDP)
- Oil resupply performance verification (SMC, NASA)
- Additive life testing (AFRL)
- Bearing cleaning evaluation (NASA)
- Retainer processing procedure (SMC)
- Solid lubricant evaluation (CDP, SMC)
- Lubricant failure analysis (SMC)

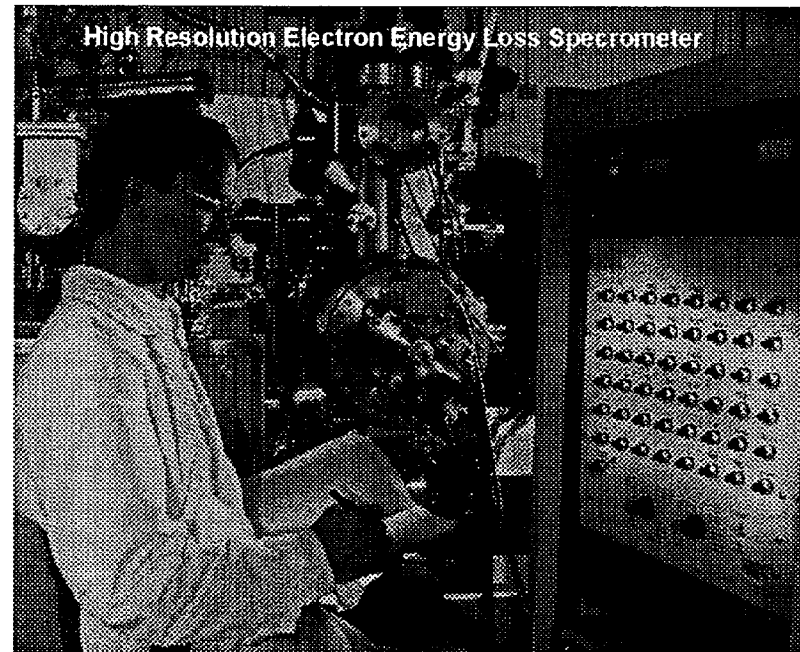
Surface Analysis

Capabilities

- X-ray photoelectron spectroscopy
- Auger electron spectroscopy
- Energy dispersive x-ray spectroscopy
- Scanning electron microscopy
- Electron energy loss spectroscopy
- Infrared spectroscopy
- Surface Profilometry

Utilization

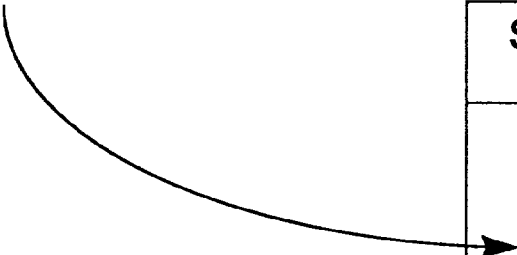
- Lubricant analysis and surface chemistry (SMC, CDP, NASA)
- Contamination identification (SMC)
- Thin film, hard coating characterization and failure analysis (CDP, UofH/AFOSR)



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Space Based Laser Support

- On call technical support in contamination and lubrication
- Current activity- literature review of potential deleterious surface chemistry from laser effluent



Species	Relative Quantity
H ₂	1
He	2
DF	2.5
HF	2
N ₂	1
D ₂	0.05